EXPANDED PROGRAMME ON IMMUNIZATION

TRAINING COURSE ON PLANNING AND MANAGEMENT

GILL TREMLETT

Disease Estimates: Introduction

WORLD HEALTH ORGANIZATION

03283

Community Health Cell
Library and Information Centre
367, "Srinivasa Nilaya"
Jakkasandra 1st Main,
1st Block, Koramangala,
BANGALORE - 560 034.
Phone : 553 15 18 / 552 53 72
e-mail : chc@sochara.org

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DISEASE ESTIMATES: INTRODUCTION

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INTRODUCTION

This module describes the first step which should be performed in countries where diseases preventable by immunization are of high priority: Estimate the morbidity and mortality due to the diseases preventable by immunization in the country. The rest of the decision-making process in implementing an expanded programme on immunization is strongly influenced by this step. Knowing the impact of the various diseases in your country will help you to determine appropriate priorities among diseases and establish reasonable objectives and targets for immunization programmes.

Once an immunization programme has been implemented, data on the morbidity and mortality due to diseases preventable by immunization can be used to evaluate the impact of the programme and to identify necessary programme changes. More information about collecting and using such data in evaluation can be found in the module titled Surveillance.

In order to estimate the impact of the diseases preventable by immunization in a country, you must perform the following steps:

- Estimate the annual incidence and incidence rates of measles, poliomyelitis, tetanus, pertussis, diphtheria, and tuberculosis.
- Estimate the annual mortality and mortality rates of measles, tetanus, pertussis, diphtheria, and tuberculosis.
- Estimate the prevalence and prevalence rates of poliomyelitis and tuberculosis.
- Estimate the frequency of various types of disability from measles, pertussis, and tuberculosis.
- Determine if seasonal variations occur in the incidence of measles.

Frequently, you will need to consult various sources of data (such as regular surveillance channels, sentinel hospitals, case registers) to obtain the information needed to perform these steps. If, as is usually the case, the information needed to perform the steps is incomplete or unavailable, you may decide that you need to conduct special studies to obtain additional data. Often, a subjective decision will need to be made about the adequacy of information and about the relative importance of various diseases in the country.

It is very difficult to obtain accurate data, but the accuracy of these data can have a substantial impact on the success of a programme. It is your responsibility to make the best decisions possible based on available data and to review and revise these decisions as you obtain additional data.

STATEMENT OF PURPOSE

In this module you will estimate the morbidity and mortality due to a disease preventable by immunization (measles, poliomyelitis, or tetanus) in Fictitia. The information you receive and the skills you practice in the module should prepare you to estimate the morbidity and mortality from diseases preventable by immunization in your country.

USING THIS MODULE

This module is designed to assist you in seeking the best available sources of information and in performing the necessary steps to determine the impact of the diseases preventable by immunization. The module consists of 3 booklets in addition to this Introduction: Disease Estimates: Measles, Disease Estimates: Poliomyelitis, and Disease Estimates: Tetanus. These booklets contain both guidelines and practice exercises for estimating the impact of those 3 diseases. Because of the limited time in the course, there are no practice exercises for estimating the impact of pertussis, diphtheria, and tuberculosis. Guidelines for estimating the impact of these latter 3 diseases are provided later in this Introduction.

Each of the 3 booklets in the module begins with a discussion of the disease taught in that booklet and a list of the steps that must be performed to estimate the importance of the disease. If after reading this discussion you decide you would like additional background information about the disease, refer to the Bibliography.

Each booklet also contains guidelines which specify what data must be collected to estimate the impact of the disease and potential sources of these data. All of the available data on Fictitia which you will need to complete the practice exercises in a booklet are contained in the booklet itself. When an exercise asks for data that are not available for Fictitia (for example, results of a serologic survey), you should go on to the next step in the exercise. However, if you feel there will be a need to obtain such data in your country, you may wish to obtain references from the Bibliography that describe how to collect the data. Then when you return to your country, you can use your country's

data and procedures similar to those contained in the booklets to determine your country's needs for expanding or revising its immunization programme.

The procedures for estimating the morbidity and mortality of pertussis, diphtheria, and tuberculosis are described on the following pages. You do not need to review the guidelines for these 3 diseases at this time. Instead, you should begin working on one of the booklets of this module which contains questions and practice exercises for the other 3 diseases--measles, poliomyelitis, and tetanus. Select a booklet on a disease which you consider to be an important problem in your country.

ESTIMATING MORBIDITY AND MORTALITY DUE TO PERTUSSIS, DIPHTHERIA, AND TUBERCULOSIS

PERTUSSIS

Pertussis, or whooping cough, is an acute communicable disease characterized by spasmodic attacks of coughing that are accompanied by an inspiratory whoop. It is a common disease among unimmunized children everywhere, regardless of race, climate, or geographic location.

To estimate the importance of pertussis in a country, the following steps should be performed:

1.0 Estimate the annual incidence and incidence rate of pertussis.
2.0 Estimate the annual mortality and mortality rate of pertussis.
3.0 Estimate the frequency of disability from pertussis.

1.0 ESTIMATE THE ANNUAL INCIDENCE AND INCIDENCE RATE OF PERTUSSIS.

Because the diagnosis of pertussis is often difficult to make, particularly in infants less than a year old who frequently lack the characteristic whoop, the accuracy of reporting of pertussis varies greatly. In fact, because of this difficulty in diagnosis, some reporting systems do not even include pertussis. The serologic test for pertussis is not very sensitive and is very difficult to perform. Therefore, serosurveys for pertussis are rarely done.

It is estimated that 80% of all children will eventually have pertussis, if there is no immunization programme. Half of these, or 40% of all children, have the characteristic symptoms of the disease.

Because pertussis is a universal health problem, even if there are no specific data which show that it occurs in a country, it should be assumed to be present unless there is evidence to the contrary. If no regional data are available, national incidence rates can be applied to each region.

The process described below can be used to estimate the annual incidence and incidence rate of pertussis.

Annual Incidence Rate Per 100,000 Population:

- Annual birth rate x Percent of live births likely to get pertussis x 100,000 = Annual incidence rate

Annual Incidence:

- Annual incidence rate ÷ 100,000 x Population = Annual incidence

2.0 ESTIMATE THE ANNUAL MORTALITY AND MORTALITY RATE OF PERTUSSIS.

In many developing countries pertussis is a major cause of death in children. Because routine reporting of pertussis mortality is rarely accurate, other methods must be used to estimate mortality. Estimates can be made using outpatient records at sentinel sites, but data obtained from these records will be very rough estimates. Data obtained from inpatient records are even less useful because they include primarily the more severe cases of pertussis.

Since pertussis mortality varies significantly with age, estimates of pertussis mortality are more accurate when based on age-specific case fatality rates (the percentage of cases that result in death in each age group) and data on age distribution of cases. In order to make reasonable estimates of age-specific case fatality rates of pertussis, a group of pertussis cases in selected areas should be followed for outcome.

If <u>both</u> age-specific case fatality rates <u>and</u> age distribution of cases data are available, the following process can be used to estimate the annual mortality and mortality rate of pertussis.

Annual Mortality:

• Annual incidence	x	Percentage distribution of cases by age	=	Annual age-specific incidence
• Annual age-specific incidence	x	Age-specific case fatality rate	=	Annual age-specific mortality
• Annual mortality for first age group	+	Annual mortality for all other age groups	=	Annual mortality

Annual Mortality Rate Per 100,000 Population:

• Annual mortality	÷	Population	x	100,000	=	Annual mortality rate

If <u>either</u> age-specific case fatality rates <u>or</u> age distribution of cases data are <u>not</u> available, estimates of pertussis mortality can still be made, but they will be less accurate. These less accurate estimates can be made if <u>both</u> overall case fatality rates <u>and</u> overall incidence data are available. The following process can be used to make these less

accurate estimates of the annual mortality and mortality rate of pertussis.

Annual Mortality:

- Annual incidence x Case fatality rate = Annual mortality

Annual Mortality Rate Per 100,000 Population:

- Annual mortality ÷ Population x 100,000 = Annual mortality rate

3.0 ESTIMATE THE FREQUENCY OF DISABILITY FROM PERTUSSIS.

Pertussis sometimes results in serious short- and long-term disabilities, such as undernutrition (particularly kwashiorkor and marasmus), pneumonia, and encephalitis. The frequency of disability, although difficult to determine accurately, is a factor which contributes to the importance of pertussis as a health problem.

Disability data can best be obtained from a longitudinal follow-up study of pertussis cases. Since these disabilities are rarely, if ever, reported as pertussis-related, and since they also often occur <u>not</u> associated with pertussis, routine reporting systems are not useful in determining the frequency of disability from pertussis. In addition, because persons with the more severe disabilities are more likely to seek medical attention, estimates based on hospital and clinic data are falsely high.

DIPHTHERIA

Diphtheria is an infection of the tonsils, pharynx, larynx, or nose. An individual with the disease will usually have toxin throughout his body and, due to the production of a diphtheritic membrane, will have nasal discharge and respiratory obstruction. An individual may also have symptoms such as cardiac failure due to the effects of the bacterial toxin. Diphtheria is not a major health problem in all countries but, when it occurs, is frequently fatal. The causative organism also infects skin lesions and can induce immunity against the more serious laryngeal infection.

To estimate the importance of diphtheria in a country, the following steps should be performed:

1.0 Estimate the annual incidence and incidence rate of diphtheria.
2.0 Estimate the annual mortality and mortality rate of diphtheria.

Although diphtheria may result in disabilities such as myocarditis and pneumonia, they are reported so rarely that realistic estimates of incidence of disabilities are not feasible.

1.0 ESTIMATE THE ANNUAL INCIDENCE AND INCIDENCE RATE OF DIPHTHERIA.

Diphtheria reporting is generally incomplete, and the disease is sometimes omitted from routine reporting systems. If diphtheria is reported routinely, these reports usually can be used to estimate the incidence of diphtheria.

Infectious disease hospitals and large pediatric hospitals are less desirable sources for diphtheria incidence data. The difficulty in computing rates of diphtheria based on data from these sentinel sites is that the total population of the region served by the health facility may not be known.

Although single cases of diphtheria are frequently not diagnosed, outbreaks, when recognized, may provide useful information for estimating incidence and mortality of the disease. Laboratory tests should be performed to confirm the diagnosis of diphtheria, since the disease may be similar to other infections such as membranous tonsilitis.

In many countries, there are significant inter-regional differences in diphtheria incidence. In any given country, it is not always valid to

use the incidence for one region to estimate the incidence of the disease in the rest of the country.

The process described below can be used to estimate the annual incidence and incidence rate of diphtheria.

Annual Incidence:

• Age-specific incidence for 1-5 year time period	÷	Number of years in time period	=	Annual age-specific incidence
• Annual incidence for first age group	+	Annual incidence for all other age groups	=	Annual incidence

Annual Incidence Rate Per 100,000 Population:

• Annual incidence	÷	Population	x	100,000	=	Annual incidence rate

2.0 ESTIMATE THE ANNUAL MORTALITY AND MORTALITY RATE OF DIPHTHERIA.

Outbreak investigations are a good source of data for estimating the annual age-specific mortality from diphtheria. Data obtained from routine surveillance systems are not as useful because they are usually from hospitals and represent only severe forms of the disease.

Since diphtheria mortality varies significantly with age, estimates of diphtheria mortality are more accurate when based on age-specific case fatality rates. In order to make reasonable estimates of age-specific case fatality rates of diphtheria, a group of diphtheria cases in selected areas should be followed for outcome.

If age-specific case fatality rates <u>are</u> available, the following process can be used to estimate the annual mortality and mortality rate of diphtheria.

Annual Mortality:

• Annual age-specific incidence	x	Age-specific case fatality rate	=	Annual age-specific mortality
• Annual mortality for first age group	+	Annual mortality for all other age groups	=	Annual mortality

Annual Mortality Rate Per 100,000 Population:

• Annual mortality	÷	Population	x	100,000	=	Annual mortality rate

If age-specific case fatality rates are not available, estimates of diphtheria mortality can still be made but they will be less accurate. These less accurate estimates can be made only if overall case fatality rates are available. The following process can be used to make these less accurate estimates of the annual mortality and mortality rate of diphtheria.

Annual Mortality:

- Annual incidence x Case fatality rate = Annual mortality

Annual Mortality Rate Per 100,000 Population:

- Annual mortality ÷ Population x 100,000 = Annual mortality rate

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TUBERCULOSIS

Tuberculosis is a chronic mycobacterial disease which is a significant cause of death and disability in many parts of the world. Everyone is at risk of acquiring tuberculosis; however, an individual may carry a tuberculosis infection throughout life and never actually develop the disease. For this reason it is important to distinguish between infection and disease when discussing the impact of the tuberculosis problem in a country. Frequent causes of disability are miliary tuberculosis, meningitis, osteomyelitis, and cavitary lung disease.

As with other diseases, the primary concern is with the amount of morbidity and mortality which result from tuberculosis. Because tuberculosis is a chronic disease, it is necessary to estimate disease prevalence (the number of all cases of disease existing in a defined population at a specific point in time) in addition to incidence. If available, information on incidence of infection can also be useful in more precisely determining the impact of the tuberculosis problem.

To estimate the importance of tuberculosis in a country, the following steps should be performed:

1.0 Estimate the annual incidence and incidence rate of tuberculosis infection.

2.0 Estimate the annual incidence and incidence rate of tuberculosis disease.

3.0 Estimate the prevalence and prevalence rate of sputum positive disease.

4.0 Estimate the annual mortality and mortality rate of tuberculosis.

5.0 Determine the rate of long-term disabilities due to tuberculosis.

1.0 ESTIMATE THE ANNUAL INCIDENCE AND INCIDENCE RATE OF TUBERCULOSIS INFECTION.

Although persons infected with the tubercle bacilli may carry the infection throughout life and never be considered clinically ill, data on infection rates may be useful in refining estimates of the tuberculosis problem.

The incidence rate of tuberculosis infection can best be determined by a tuberculin skin test survey. Customarily this type of survey is done by skin testing a random sample of school children (for example, 5-year-olds).

One caution that must be taken in these surveys is not to test children with a history or mark of BCG vaccination, because of possible vaccine-induced tuberculin sensitivity.

The following process can be used to estimate the annual incidence and incidence rate of tuberculosis infection. The process assumes that the study population is fully representative of the whole population under review.

Annual Incidence Rate Per 100,000 Population:

- Percent with positive skin tests in study population ÷ Average age in study population x 100,000 = Annual incidence rate of tuberculosis infection in study population

Annual Incidence:

- Annual incidence rate of infection in study population ÷ 100,000 x Population = Annual incidence of infection

2.0 ESTIMATE THE ANNUAL INCIDENCE AND INCIDENCE RATE OF TUBERCULOSIS DISEASE.

It is estimated that 5% (0.05) of those persons with tuberculosis infection will eventually get tuberculosis disease.

The following process can be used to estimate the annual incidence and incidence rate of tuberculosis disease.

Annual Incidence Rate Per 100,000 Population:

- Annual incidence rate of tuberculosis infection x 0.05 = Annual incidence rate of tuberculosis disease

Annual Incidence:

- Annual incidence rate of tuberculosis disease ÷ 100,000 x Population = Annual incidence rate of tuberculosis disease

3.0 ESTIMATE THE PREVALENCE AND PREVALENCE RATE OF SPUTUM POSITIVE DISEASE.

Prevalence data can be obtained from a random sample survey of the population to determine the number who are sputum positive.

The following process can be used to estimate the prevalence and prevalence rate of sputum positive tuberculosis disease.

Prevalence Rate Per 100,000 Population:

- Rate of sputum positive disease in study population x 100,000 = Prevalence rate of sputum positive tuberculosis disease

Prevalence:

- Prevalence rate of sputum positive disease ÷ 100,000 x Population = Prevalence of sputum positive disease

4.0 ESTIMATE THE ANNUAL MORTALITY AND MORTALITY RATE OF TUBERCULOSIS.

Untreated tuberculosis and its disability result in high mortality rates of tuberculosis in many developing countries. Estimates of the case fatality rate from tuberculosis registers in hospitals are under-estimates of overall mortality because of the treatment received by hospital patients.

The following process can be used to estimate the annual mortality and mortality rate of tuberculosis.

Annual Mortality:

- Case fatality rate x Annual incidence = Annual mortality

Annual Mortality Rate Per 100,000 Population:

- Annual mortality ÷ Population x 100,000 = Annual mortality rate

5.0 DETERMINE THE RATE OF LONG-TERM DISABILITIES DUE TO TUBERCULOSIS.

Tuberculosis is a destructive disease. Generally, once an organ is destroyed by tuberculosis it cannot regenerate, leading to a reduction in function of that organ.

Serious long-term disabilities due to tuberculosis include brain damage from tuberculosis meningitis, respiratory failure due to destruction of lung tissue by cavitary disease, renal failure, sterility, and chronic infections of skin, bone, and lymphatic tissue. Data needed to estimate the rate of disabilities from tuberculosis can be obtained from hospitals and tuberculosis clinics.